

CATCH AND EFFORT STATISTICS FOR THE COHO
SALMON (*Oncorhynchus kisutch*) SPORT FISHERY IN
THE LITTLE SUSITNA RIVER WITH ESTIMATES OF
ESCAPEMENT, 1986

By: Robert W. Bentz, Jr.



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ABSTRACT

Roving and direct expansion creel surveys were conducted at four access sites on the Little Susitna River to estimate angler-effort for and harvest of coho salmon (*Oncorhynchus kisutch* Walbaum). An estimated 6,098 coho salmon were harvested and an additional 993 coho salmon were caught and released in 42,869 angler-hours of effort. Most of the effort, harvest, and catch occurred in the lower portion of the river. Sport anglers using salmon eggs as bait achieved harvest rates three times higher than anglers using artificial lures.

A weir was installed in the Little Susitna River to estimate coho salmon escapement. Total coho salmon inriver return was estimated at 13,097 of which 6,999 escaped the sport fisheries. The estimated hatchery contribution to the inriver return was 6.6 percent.

KEY WORDS: northern Cook Inlet, coho salmon, *Oncorhynchus kisutch*, creel survey, weir, harvest, catch, effort, escapement.

INTRODUCTION

There are approximately 25 streams within the Knik Arm and east side Susitna River areas of northern Cook Inlet that support sport fisheries for coho salmon (*Oncorhynchus kisutch* Walbaum). Of these, the Little Susitna River (Figure 1) is the largest in angler-effort and harvest (Mills 1979-1986). The Little Susitna River supports the second largest freshwater recreational fishery for coho salmon in Alaska being surpassed only by the Kenai River (Mills 1979-1986). The river provides an exceptional opportunity to harvest coho salmon as more than 70 miles of river are available to fishing by boat. A detailed description of the river and the existing coho salmon sport fishery is presented in Bentz (1983).

Angler-effort on the Little Susitna River has increased 339% from 1977 through 1984 (Mills 1979-1986). Much of this increase was a direct result of improvements during the last 4 years to the road that provides access to the lower river. Increases in fishing effort are expected to continue as access road improvements are completed and other support facilities such as campground and boat launch sites are constructed. In conjunction with the increased angler-effort, estimated coho salmon harvests have also risen dramatically, from 3,415 fish in 1977 to a peak of 14,253 fish in 1984.

Since 1981, the Sport Fish Division of the Alaska Department of Fish and Game (ADF&G) has conducted a creel survey to estimate harvest and effort for this rapidly expanding fishery. In addition to the creel survey program, a study was initiated in 1982 to estimate key life history parameters of Little Susitna River coho salmon including: run timing, migration rates, important holding areas, and distribution and magnitude of spawning (Bentz 1982-1986). This work revealed that catch and release fishing for coho salmon with natural bait (i.e., salmon eggs) is a common practice by anglers on the Little Susitna River. Resource managers are concerned that this could cause significantly higher mortality than is already sustained by the harvest.

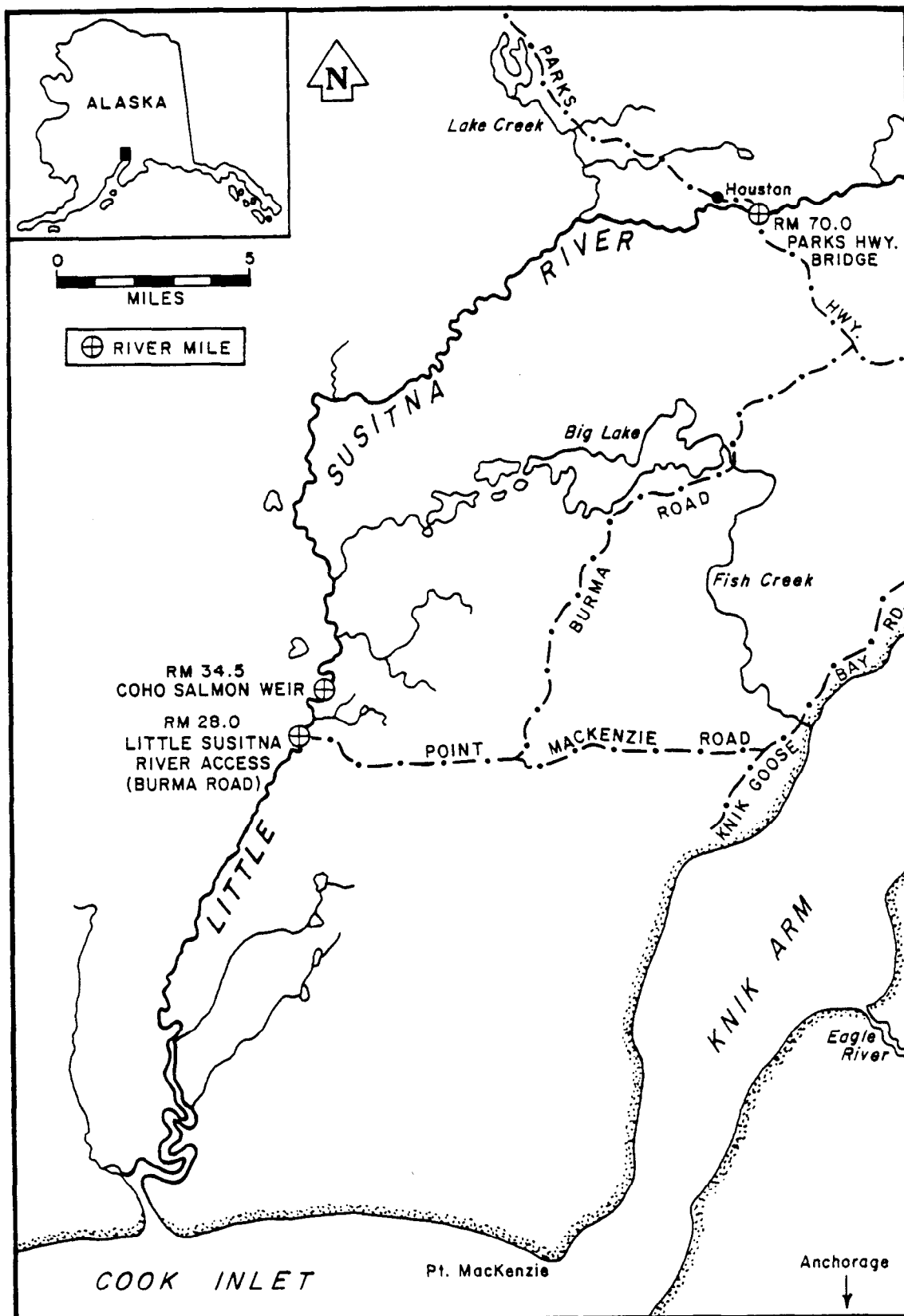


Figure 1. Study area of the Little Susitna River.

In response to increased angler demands, the Little Susitna River has been identified as the top priority for coho salmon enhancement in Cook Inlet (ADF&G 1981). Stocking was begun in 1981 and the first large returns of coho salmon (approximately 2,100 fish) were anticipated in 1986 (Chlupach 1986). The return in 1987 is projected to be 9,500 coho salmon.

In 1986, the Little Susitna River study program was expanded to include a weir for estimation of escapement and a study to estimate hooking mortality of released fish. The objectives of this report are to present: (1) sport fishery harvest and effort statistics along with angler characteristics; (2) coho salmon population statistics including estimation of hatchery-reared coho salmon, sex ratio, and age and length composition; and (3) minimum escapement estimates for the Little Susitna River and other northern Cook Inlet index streams.

METHODS

The area open to coho salmon fishing on the Little Susitna River encompasses 70 river miles and has four major access points (Figure 1). The Burma Road and Parks Highway provide angler access to the lower and upper river fishing areas, respectively. The Burma Road access site is located 28 river miles above salt water. Anglers reach this site primarily by vehicle. The Parks Highway access site is located at Milepost 57 of the Parks Highway in the town of Houston. Millers Landing is a privately owned boat launch facility and is approximately 1 mile downstream of the Parks Highway bridge. A fourth access site is the Ship Creek boat launch in Anchorage. This site is used by anglers that boat across the marine waters of Knik Arm and fish in the lower river 4 to 12 miles below the Burma Road access¹ site. Creel surveys were used to estimate effort, harvest, and catch¹ at these four access sites.

During 1986, anglers were permitted a daily bag and possession limit of three coho salmon (ADF&G 1986). Fishing time was not restricted by regulation. The Little Susitna River coho salmon sport fishery was closed by Emergency Order effective 15 August 1986 because of a smaller than expected return of coho salmon.

Direct Expansion Creel Surveys

Direct expansion creel surveys were used to estimate angler-effort, harvest (fish retained), and catch (fish landed) by most shore anglers and all boat anglers at the Burma Road access site and boat anglers at the Ship Creek and Millers Landing access sites. A direct expansion creel survey censuses all anglers departing a fishery for effort and catch during specified periods of time and then expands those numbers to include those periods of time not censused to estimate effort, harvest, and catch.

Study Design:

The length of the fishing day was defined as 16 hours (0600-2200 hours) for all survey locations except Ship Creek. Each day was divided into

¹ Total number of fish landed including fish harvested and fish released.

four, 4-hour sample periods: (1) 0600-0959 hours; (2) 1000-1359 hours; (3) 1400-1759 hours; and (4) 1800-2200 hours. Weekdays and weekend/holidays were separate strata.

The creel survey at Burma Road was conducted from 7 July through 14 August. Eighteen 4-hour periods were sampled each week. All four periods were sampled each weekend day. Two randomly selected periods were sampled each weekday.

The creel survey at Ship Creek was conducted from 12 July through 11 August. Boat travel to and from Ship Creek is restricted to the two daily high tides because of extreme tidal fluctuations in Knik Arm. Therefore, sampling occurred only during the high tide periods. Each sample period was 4 hours in duration and began 2 hours prior to the time of high slack tide. Both high tide periods were sampled each weekend day, and five randomly selected periods were sampled during 4 randomly selected weekdays of each week.

The Millers Landing creel survey was conducted from 26 July through 14 August. Twelve periods were sampled each week. Either two or three periods were sampled each weekend day and one or two periods were sampled each weekday.

A stratified-random sampling design was used for all the direct expansion creel surveys except at Ship Creek where a systematic sampling design was used. Each survey was stratified by weekday/weekend and by boat/shore anglers where appropriate. Time periods (A, B, C, etc.) within the weekdays and weekends were selected at random without replacement. Only completed-trip anglers were surveyed. Anglers exiting the fishery without being interviewed were tallied.

Assumptions necessary for the direct expansion creel survey are:

1. No significant fishing effort occurs during the hours 2200-0600;
2. Anglers exit the fishery only at the sites surveyed and only during the times allowed for in the survey; and
3. Interviewed anglers are representative of the total angler population.

Data Collection:

Interviews were conducted at major access points where anglers exited the fishery. All anglers leaving the fishery were considered completed-trip anglers. The following data were collected from interviewed anglers: effort (in hours), harvest (number of fish kept by species), catch (number of fish caught by species), and gear used. Harvested coho salmon were randomly sampled for biological data (sex, length, and age).

Analysis:

Estimation of effort (\hat{E}), harvest (\hat{H}), and catch (\hat{C}) for the direct expansion creel surveys were estimated as:

$$(\hat{E}) = (\text{hours possible/hours interviewed}) \times [\text{missed anglers} \times (\text{hours fished/anglers interviewed}) + \text{hours fished}],$$

$$(\hat{H}) = (\text{hours possible/hours interviewed}) \times [\text{missed anglers} \times (\text{observed harvest/anglers interviewed}) + \text{observed harvest}], \text{ and}$$

$$\hat{u}_{pib} = (\text{hours possible/hours interviewed}) \times [\text{missed anglers} \times (\text{observed catch/anglers interviewed}) + \text{observed catch}]$$

Roving Creel Surveys

Creel surveys that used a roving design (Neuhold and Lu 1957) were used to estimate angler-effort and catch by a portion of shore anglers at the Burma Road access site and for all shore anglers at the Parks Highway bridge. Some shore anglers fished near the Burma Road access but did not exit the fishery through this point. Therefore, they were not available for interviews through the direct expansion survey described previously.

Study Design:

The length of the fishing day was defined as 16 hours (0600-2200 hours) and was stratified identically to the direct expansion creel surveys. Weekdays and weekend/holidays were treated as separate strata.

Only angler counts were conducted for the shore-angler fishery above and below Burma Road. Harvest and catch rates were assumed to be similar to anglers who exited through the Burma Road access site. Counts of shore anglers fishing approximately 1 river mile above or below the Burma Road access site were conducted five times each week. One angler count was conducted on every weekend day and on 3 randomly selected weekdays.

The survey at the Parks Highway bridge access site was conducted from 26 July through 14 August. Six periods (A, B, C, etc.) were selected for conducting angler interviews each week. Either one or two periods were sampled during each weekend day and one period was sampled on 3 randomly selected weekdays. Sixteen angler counts were conducted each week. Either three or four counts were conducted each weekend day and from one to three counts were conducted on each weekday.

A two-stage random sample design was used for angler counts. Days were considered the primary sample units and hours in a day were the secondary sample units. Angler counts were considered instantaneous counts (Neuhold and Lu 1957). Several assumptions were necessary for this sampling design:

1. Angler counts made during the same day and on consecutive days are independent;
2. No significant fishing effort occurs during the hours of 2200-0600;

3. Interviewed anglers are representative of the total angler population at the Parks Highway bridge;
4. Shore anglers fishing 1 mile above or below the Burma Road access site did not enter or exit the fishery through the angler interview site;
5. Shore anglers who fished 1 mile above or below the Burma Road access site experienced harvest and catch rates similar to those shore anglers interviewed at the access site;
6. The number of anglers interviewed during any day in a stratum is proportional to the effort on that day; and
7. Fishing effort does not influence catch per unit effort.

Data Collection:

During a selected sample period, a random starting time within the period was selected to count the number of anglers. Survey personnel used skiffs to count shore anglers 1 mile above and below the Burma Road access site. Foot surveys were conducted at the Parks Highway bridge access site to count anglers fishing from shore. At the start of a selected count time, a coin was tossed to determine the starting point (upstream/downstream) from which the counts were to be initiated.

Angler interviews at the Parks Highway bridge were conducted as people exited the fishery through the major access points; only anglers who had completed their fishing trip were interviewed. Anglers fishing from shore 1 mile above or below the Burma Road access site were not interviewed.

Harvest rates from shore anglers interviewed at the Burma Road site were used to estimate harvest by this group of shore anglers. The same sets of angler interview and biological data as collected during the direct expansion creel surveys were collected in the roving surveys.

Analysis:

Effort and harvest rates were computed following a two-stage sampling design with a finite number of primary sampling units and an unknown number of secondary units (Sukhatme et al. 1984, Von Geldern and Tomlinson 1973).

Effort. The mean number of anglers per count and total effort in angler hours was computed by week for each weekend/holiday and weekday strata for each sampling location. The following conventions are used for analytical notation:

i = days,

j = sample in day i ,

d = total number of days on which sampling was conducted,

D = total number of possible days in a week,

N = total number of possible hours of fishing in a week,

y_{ij} = an angler count,

\bar{Y}_i = mean angler count for day i,

\bar{Y} = mean angler count for a week,

m_i = number of angler counts on day i, and

M = total number of angler counts for a week.

Effort in angler-hours, E, was estimated for each week as:

$$\hat{E} = \bar{Y}N.$$

The variance of \hat{E} was estimated as:

$$\hat{V}(\hat{E}) = N^2 V(\bar{Y}), \text{ where}$$

$$V(\bar{Y}) = [1-(d/D)] s_B^2/d + [\sum_{i=1}^d (s_{Wi}^2/m_i)]/dD,$$

$$s_B^2 = [\sum_{i=1}^d (\bar{Y}_i - \bar{Y})^2]/(d-1), \text{ and}$$

$$s_{Wi}^2 = [\sum_{j=1}^{m_i} (y_{ij} - \bar{Y}_i)^2]/(m_i-1).$$

Harvest Rates. Harvest rates were computed for each sampled day and for the strata used for the angler-effort estimates. For any week, the following conventions are used for analytical notation:

C = total harvest by anglers interviewed during a week,

F = total effort (angler-hours) by anglers interviewed during a week,

\bar{C} = mean harvest per angler,

\bar{F} = mean effort per angler,

M = number of anglers interviewed in a week,

$s_{\bar{C}}^2$ = variance of \bar{C} ,

$s_{\bar{F}}^2$ = variance of \bar{F} , and

R = correlation coefficient for individual angler effort and catches.

Catch per effort, \hat{C}/\hat{F} , was computed for each stratum and its variance computed as (Jessen 1978):

$$V(\hat{C}/\hat{F}) = (\hat{C}/\hat{F})^2 [(s_{\bar{C}}^2/\bar{C}) + (s_{\bar{F}}^2/\bar{F}) - (2Rs_{\bar{C}}^2 s_{\bar{F}}^2 / \bar{C}\bar{F})].$$

The variance for mean harvest and mean effort per angler was computed using the two-stage formulae previously defined for mean angler counts. The y_i 's represent the effort or catch of an interviewed angler and m_i 's represent the total number of anglers interviewed on day i .

Total Harvest. Total harvest, \hat{H} , for any week was computed as:

$$\hat{H} = \hat{E}(\hat{C}/\hat{F})$$

and its variance estimated using the formula for the product of two independent random variables (Goodman 1960):

$$\hat{V}(\hat{H}) = [\hat{E}^2 V(\hat{C}/\hat{F})] + [(\hat{C}/\hat{F})^2 V(\hat{E})] - [V(\hat{E}) V(\hat{C}/\hat{F})].$$

Catch rates and total catch were computed as described above except that catch data were substituted for harvest data.

Escapement

A weir was installed across the Little Susitna River at River Mile 34.5, approximately 6.5 miles above the Burma Road access site. The weir provided a count of all coho salmon which escaped the downstream sport fishery. Water depth at the weir normally ranged from 0.3 to 0.8 m. The weir was 45.7 m in length and was constructed of 12 panels that were 3.8 m long and 1.3 m high, and made of 0.5 cm x 7.6 cm aluminum channel. Intermediate grade conduit (2.5 cm diameter) 3.0 m in length was inserted into 5.7 cm center-to-center holes in the panels. One panel was hinged at the bottom so it could be lowered to the river bottom to allow boat passage through the weir. The weir sections were placed at an obtuse angle against the current and supported vertically against the streambed by tripods constructed from 10 cm x 15 cm timbers.

A holding box 1.2 m wide, 2.4 m long and 1.2 m high was constructed out of 1.3 cm thick plywood. The box was attached to the upstream face of the weir. Fish were allowed to swim into the box by removal of two pieces of conduit from the weir panel directly downstream of the box. All salmon migrating past the weir were collected in this box. Weir personnel determined the species and number of fish prior to their release above the weir.

Age, Sex, and Length Data

Fish from the harvest were sampled for scales, sex, and length at the Burma Road and Millers Landing survey locations. Only sex data were collected at the Ship Creek location. Fish from the escapement were sampled at the weir. All sampled fish were inspected for the absence of the adipose fin which identified them as hatchery-reared fish. Scales were collected on the left side of the fish approximately two rows above the lateral line and on the diagonal row downward from the posterior insertion of the dorsal fin (Clutter and Whitesel 1956). Scales were mounted on adhesive-coated cards and impressions were made in cellulose acetate (Clutter and Whitesel 1956).

Scales were examined using a microfiche reader to determine age. The European method was used to denote anadromous age classes. The first numeral refers to the number of years of freshwater residence after emergence. The second number refers to the number of years of marine residence. Fish lengths were measured from middle-of-the-eye to fork-of-tail to the nearest 0.5 cm.

The proportional age compositions of the coho salmon harvest and escapements were estimated by sex. Letting p_h equal the estimated proportion of age group h , the variance of p_h was estimated using the normal approximation to the binomial (Cochran 1977):

$$V(\hat{p}_h) = \hat{p}_h(1-\hat{p}_h)/(n_T-1),$$

where n_T is the number of legible coho salmon scales read.

Mean length at age by sex and its variance were estimated using standard normal procedures.

Heads from fish with missing adipose fins were collected for decoding coded wire tags (CWT). Release and recovery data, and contribution estimates, have been reported by Chlupach (1987). However, we have recomputed the contribution estimates (Appendix C) using the methods described in Vincent-Lang (in press).

Escapement Surveys of other Northern Cook Inlet Systems

Coho salmon spawning populations were counted during stream surveys on established index streams within northern Cook Inlet and are considered minimum escapement estimates. Surveys were conducted during the peak spawning period. This period was identified through frequent inspections of coho spawning activity in index streams which are easily accessible. Additional escapement data were collected from a weir located on Fish Creek.

RESULTS

Harvest, Catch, and Effort

Temporal changes were evident in the fishery. Harvest and catch in the Burma Road boat fishery peaked during the period 28 July to 1 August (Table 1 and Figure 2). Harvest and catch in the Ship Creek fishery also peaked during this period and the previous weekend (26 July to 27 July). Effort, harvest, and catch in the upper river fishery (Millers Landing) were greatest after 4 August.

The estimates of effort and harvest by anglers fishing the Little Susitna River during the period 7 July to 14 August¹ were 42,869 angler-hours and 6,098 coho salmon, respectively (Table 2). An additional 993 coho salmon were estimated as caught and released during this period. Most of the effort (38%), harvest (66%), and catch (68%) occurred in the Burma Road boat fishery. Burma Road shore anglers comprised the second largest concentration of effort and, in combination with Burma Road boat anglers, accounted for 61% of the total effort. The lower river fishery (all Burma Road and Ship Creek anglers) accounted for the majority of the effort (71%), harvest (92%), and catch (92%).

Gear Type

The use and effectiveness of bait differed between the lower and upper river fisheries (Table 3 and Figure 3). Anglers using bait in the lower river accounted for most of the effort (72%) and coho salmon catch (77%). However, in the upper river, anglers using bait accounted for only 12% of the effort, but 59% of the coho salmon catch. In both the lower and upper river fisheries, a greater percentage of boat anglers used bait than did shore anglers.

Escapement

The weir was installed on 17 July and was operational, except for two short periods of time, continuously through 8 September. From 21 July to 24 July, one-third of the conduit pickets were removed from the weir panels to prevent the weir from being washed out by high water. A portion of the weir collapsed during flood stage flows on 27 July and was not fully operational until 30 July.

A total of 7,511 coho salmon were counted as they migrated past the weir (Appendix B). After subtracting the 512 fish harvested by anglers fishing upstream of the weir, the estimated spawning escapement of coho salmon to the Little Susitna River in 1986 was 6,999 fish. The total instream return of coho salmon was estimated at 13,097 fish. Forty-seven percent (6,098) of the instream return was harvested by sport anglers.

¹ The fishery was closed by emergency order on 15 August in response to a weak return. If unclosed, the fishery (and creel survey) would have continued through the Labor Day holiday in September.

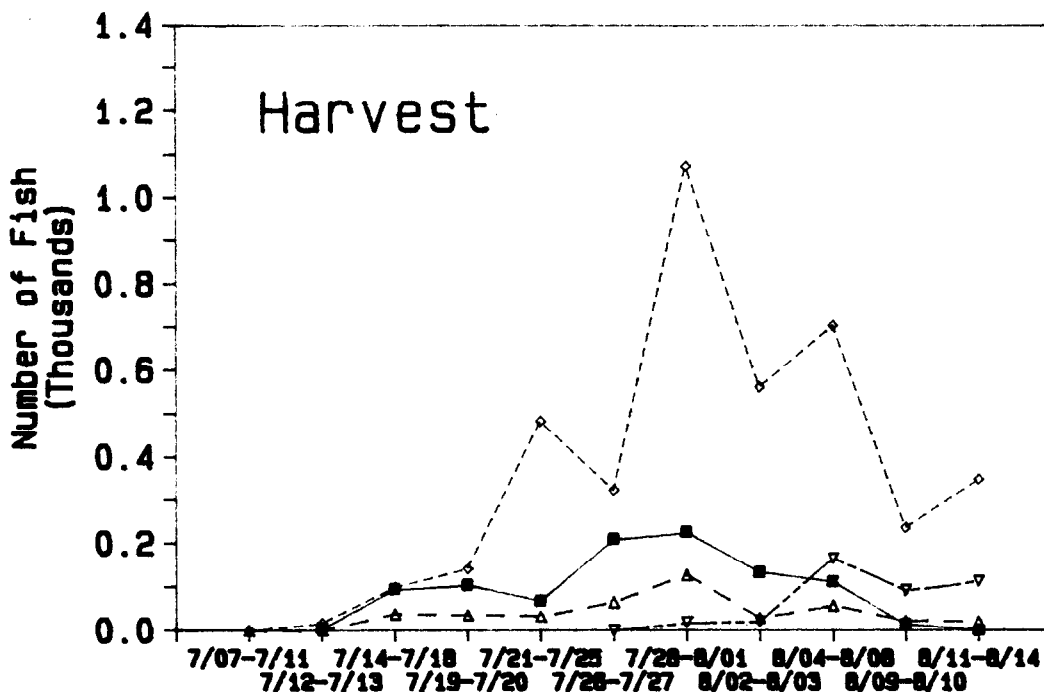
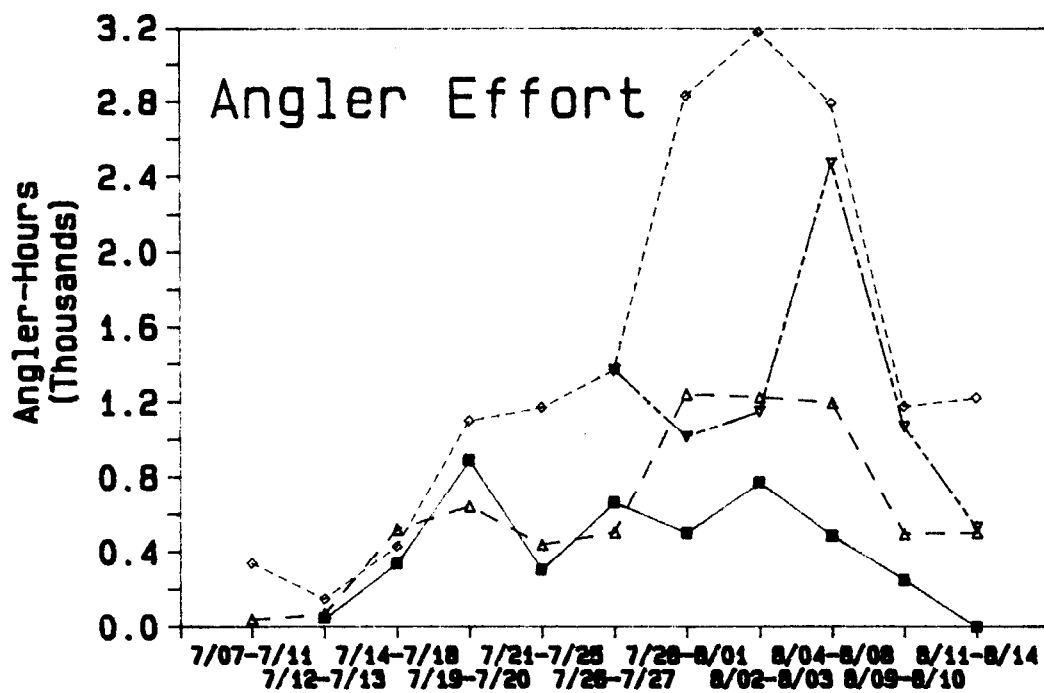
Table 1. Effort, coho salmon harvest, and coho salmon catch by fishery and week for the Little Susitna River, 1986.

		Effort ¹				Harvest				Catch			
Time Frame	Strata	Ship	Burma Road Boat	Burma Road Shore ²	Millers Landing	Ship Creek	Burma Road Boat	Burma Road Shore ²	Millers Landing	Ship Creek	Burma Road Boat	Burma Road Shore ²	Millers Landing
		Creek											
Wd	7/07-7/11		341.6	47.6			0	0			0	0	
We	7/12-7/13	49.3	150.9	74.1		5	17	1		5	17	1	
Wd	7/14-7/18	341.7	433.9	526.3		95	100	39		100	102	52	
We	7/19-7/20	893.0	1,107.3	646.4		105	142	36		105	166	39	
Wd	7/21-7/25	306.0	1,176.2	441.8		68	484	33		68	515	33	
We	7/26-7/27	666.5	1,369.0	510.3	1,373.8	211	324	66	0	243	340	72	0
Wd	7/28-8/01	502.5	2,836.2	1,247.8	1,020.8	227	1,075	129	19	245	1,301	131	19
We	8/02-8/03	774.0	3,177.5	1,227.6	1,155.8	133	561	29	21	164	642	29	21
Wd	8/04-8/08	487.0	2,793.8	1,198.8	2,477.0	112	704	58	167	122	952	58	174
We	8/09-8/10	250.0	1,181.7	498.2	1,072.1	13	237	22	92	13	297	22	94
Wd	8/11-8/14 ³	0.0	1,226.9	506.5	531.0	0	350	21	114	0	457	21	180
Total		4,270.0	16,395.0	6,925.4	7,630.6	969	3,994	436	413	1,065	4,789	458	488

¹ Angler-hours

² Only includes anglers who exited the fishery through Burma Road. Temporally stratified estimates are not available for shore anglers who exited the fishery above and below Burma Road.

³ Ship Creek estimates only through 8/11.



—■— Ship --◇-- Burma (Boat) ▲ - Burma (Shore) ▽-- Millers

Figure 2. Effort and harvest of coho salmon by fishery and week, Little Susitna River, 1986.

Table 2. Total effort, coho salmon harvest, and coho salmon catch by fishery, Little Susitna River, 1986.

Location	Angler Type	Effort		Harvest		Catch	
		Ang-Hrs	%	Number	%	Number	%
Ship Creek	Boat	4,270.0	10.0	969	15.9	1,065	15.0
Burma Road	Boat	16,395.0	38.2	3,994	65.5	4,789	67.5
Burma Road	Shore	9,794.4	22.8	623	10.2	650	9.2
Lower River Sub-Total		30,459.4	71.0	5,586	91.6	6,504	91.7
Millers Landing	Boat	7,630.6	17.8	413	6.8	488	6.9
Highway Bridge	Shore	4,779.0	11.2	99	1.6	99	1.4
Upper River Sub-Total		12,409.6	29.0	512	8.4	587	8.3
GRAND TOTAL		42,869.0	100.0	6,098	100.0	7,091	100.0

Table 3. Use of bait¹ and artificial lures by anglers in the Little Susitna River sport fisheries, 1986.

Location	Angler Type	Gear Type	Percent of:		
			Effort ²	Harvest	Catch
Ship Creek	Boat	Bait	95	97	97
		Lure	5	3	3
Burma Road	Boat	Bait	73	73	72
		Lure	27	27	28
Burma Road	Shore	Bait	50	81	81
		Lure	50	19	19
Lower River Sub-Total		Bait	72	79	77
		Lure	28	21	23
Millers Landing	Boat	Bait	19	64	65
		Lure	81	36	35
Highway Bridge	Shore	Bait	4	31	31
		Lure	96	69	69
Upper River Sub-Total		Bait	12	57	59
		Lure	88	43	41
GRAND TOTAL		Bait	54	77	76
		Lure	46	23	24

¹ Eggs

² Angler-hours

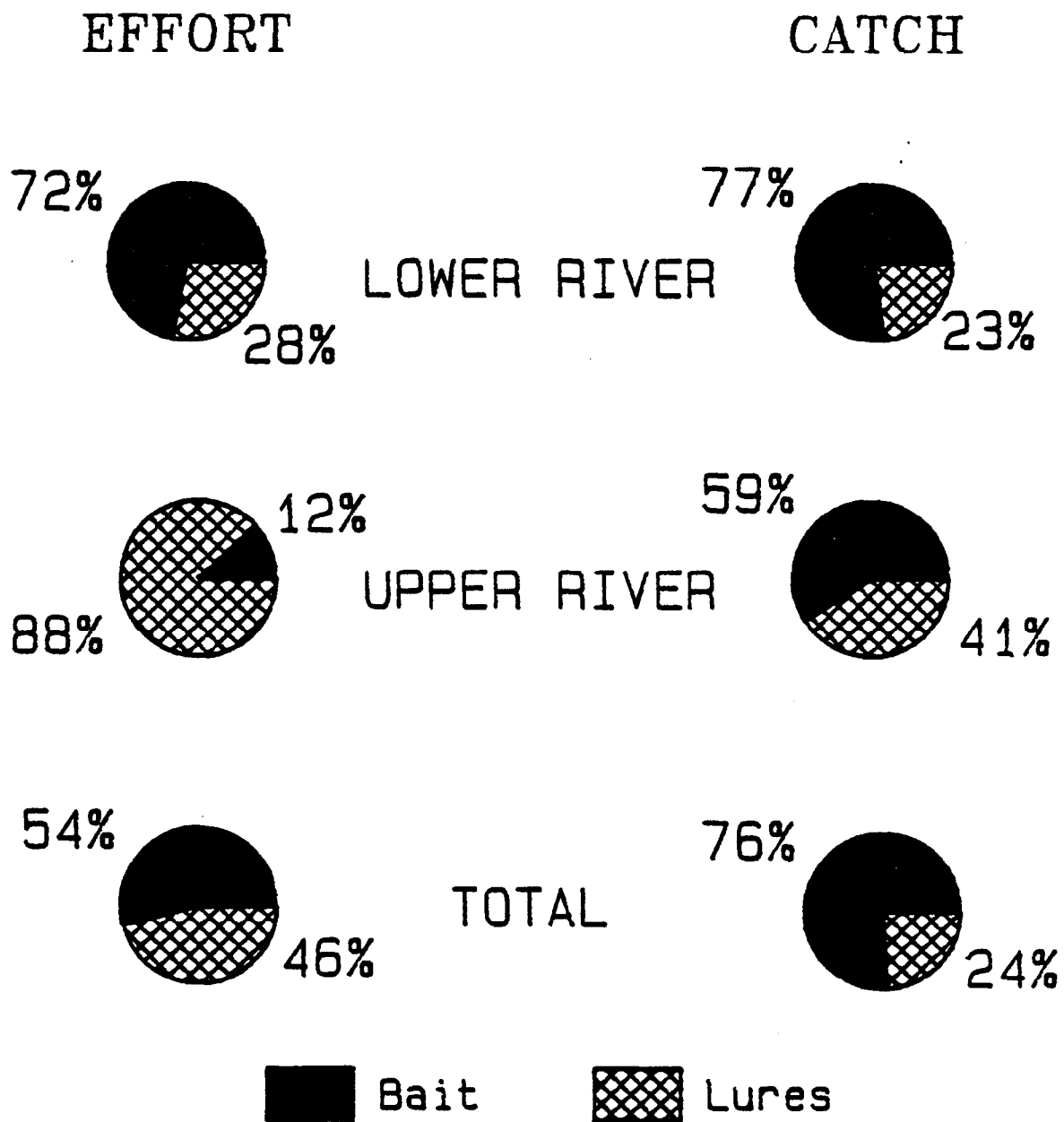


Figure 3. Use of bait and artificial lures by anglers in the Little Susitna River sport fisheries, 1986.

Results of coho salmon escapement surveys for index streams in the Anchorage and Matanuska Valley areas are presented in Appendix B. High water resulting from a 100-year area-wide flood during the period of coho salmon spawning prevented escapement surveys on most index streams. A total of 271 coho salmon were counted in the Anchorage bowl area. Rabbit Creek accounted for 62% of the total. In the Matanuska Valley, 2,873 coho salmon were counted with Fish Creek accounting for 75% of the total.

Population Structure

Age 2.1 coho salmon were the most abundant age class in both the sport harvest and escapement (Table 4). This age class comprised 89% of the coho salmon harvested by sport anglers and 90% of the coho salmon sampled at the weir. Age 1.1 coho salmon accounted for 8% and 7% of the fish harvested in the sport fishery and sampled at the weir, respectively. The age compositions for males, females, and both sexes combined were compared between the fishery and escapement with the chi-squared test. No significant differences in age compositions were found ($p = 0.05$). Mean length of coho salmon harvested by sport anglers was similar to the mean length of coho salmon sampled at the weir (Table 5).

Temporal trends in sex composition were evident for the fishery and escapement (Table 6 and Figure 4). In both data sets, the fraction of females declined over time. The lower river sport fishery harvested a higher fraction of females than was observed at the weir. This is probably a result of the fishery being restricted to the front end of the migration when females were abundant.

Coho salmon harvested by sport anglers and those observed at the weir were examined for an adipose finclip. This clip was the identifying mark for a hatchery-reared fish. The estimated hatchery contribution to the instream coho salmon return was 6.6% (Appendix C). However, the low recovery rate of CWT's from ad-clipped fish (only 12 CWT's were recovered from 21 fish) lessens confidence in this estimate.

DISCUSSION

Despite the emergency closure of the fishery, the third largest coho salmon harvest in the history of the fishery occurred. The estimated escapement of 7,000 coho salmon were fewer fish than were observed in aerial and foot surveys during most previous years. The effectiveness of the fishery can be attributed to high concentrations of effort and vulnerability of fish in the lower river rather than to high levels of abundance.

With the absence of quantitative return estimates from previous years, it is difficult to assess whether the weak return in 1986 was due to low brood escapement, recruitment failure, or marine commercial harvest in the waters of Cook Inlet. Of concern to managers is the near record commercial harvest of coho salmon (744,000) during 1986 (Ruesch and Browning 1986). The contribution of Little Susitna River origin fish to this harvest is not known.

Table 4. Sex and age composition of coho salmon from the sport fishery and escapement in the Little Susitna River, 1986.

Segment	Sex	Statistic	Age Class				
			2.2	3.1	2.1	1.1	All
Sport Fishery ¹	Male	Sample Size	1	1	123	13	138
		Percent	0.37	0.37	45.90	4.85	51.49
		St. Error	0.37	0.37	3.05	1.31	3.06
	Female	Sample Size	2	4	115	9	130
		Percent	0.75	1.49	42.91	3.36	48.51
		St. Error	0.53	0.75	3.03	1.10	3.06
	Combined	Sample Size	3	5	238	22	268
		Percent	1.12	1.87	88.81	8.21	100.00
		St. Error	0.64	0.83	1.93	1.68	
Escapement ²	Male	Sample Size	1	7	253	19	280
		Percent	0.25	1.73	62.62	4.70	69.31
		St. Error	0.25	0.65	2.41	1.05	2.30
	Female	Sample Size		2	111	11	124
		Percent		0.50	27.48	2.72	30.69
		St. Error		0.35	2.22	0.81	2.30
	Combined	Sample Size	1	9	364	30	404
		Percent	0.25	2.23	90.10	7.43	100.00
		St. Error	0.25	0.74	1.49	1.31	

¹ Samples from Burma Road (n = 212) and Millers Landing (n = 56).

² Samples from weir.

Table 5. Length¹ (mm) by sex and age class of coho salmon from the sport fishery and escapement in the Little Susitna River, 1986.

Segment	Sex	Statistic	Age Class			
			2.2	3.1	2.1	1.1
Sport Fishery ²	Male	Sample Size	1	1	123	13
		Mean	595	595	590	588
		St. Error			7.2	9.4
	Female	Sample Size	2	4	115	9
		Mean	568	611	566	576
		St. Error	2.8	10.1	7.8	9.0
Escapement ³	Male	Sample Size	1	7	253	19
		Mean	440	621	604	588
		St. Error		15.3	2.3	32.6
	Female	Sample Size		2	111	11
		Mean		610	573	569
		St. Error		10.0	5.5	15.7

¹ Mid-eye to fork-of-tail length.

² Samples from Burma Road (n = 212) and Millers Landing (n = 56).

³ Samples from weir.

Table 6. Percent composition of females in the sport fishery and escapement in the Little Susitna River, 1986.

Lower River Fishery ¹					Upper River Fishery ²				:	Escapement ³				
Strata	Sample Size	Percent Females	95% CI		Sample Size	Percent Females	95% CI		:	Strata	Sample Size	Percent Females	95% CI	
			Low	High			Low	High	:				Low	High
7/12-7/18	99	70.7	61.7	79.7					:					
7/19-7/25	188	48.4	41.2	55.6					:					
7/26-8/01	871	44.4	41.1	47.7	6	66.7	25.4	100.0	:	7/19-8/08	120	41.6	32.7	50.5
8/02-8/08	902	46.7	43.4	50.0	71	64.8	53.6	76.0	:					
8/09-8/14	267	36.7	30.9	42.5	91	59.3	49.2	69.4	:	8/09-8/15	374	29.1	24.5	33.7
									:					
									:	8/16-9/12	213	28.6	22.5	34.7
Total	2,327	45.9	32.9	58.8	168	61.9	21.4	100.0	:		707	31.1	19.9	42.2

¹ Samples from Ship Creek (N=455) and Burma Road (N=1,872).

² Samples from Millers Landing.

³ Samples from weir.

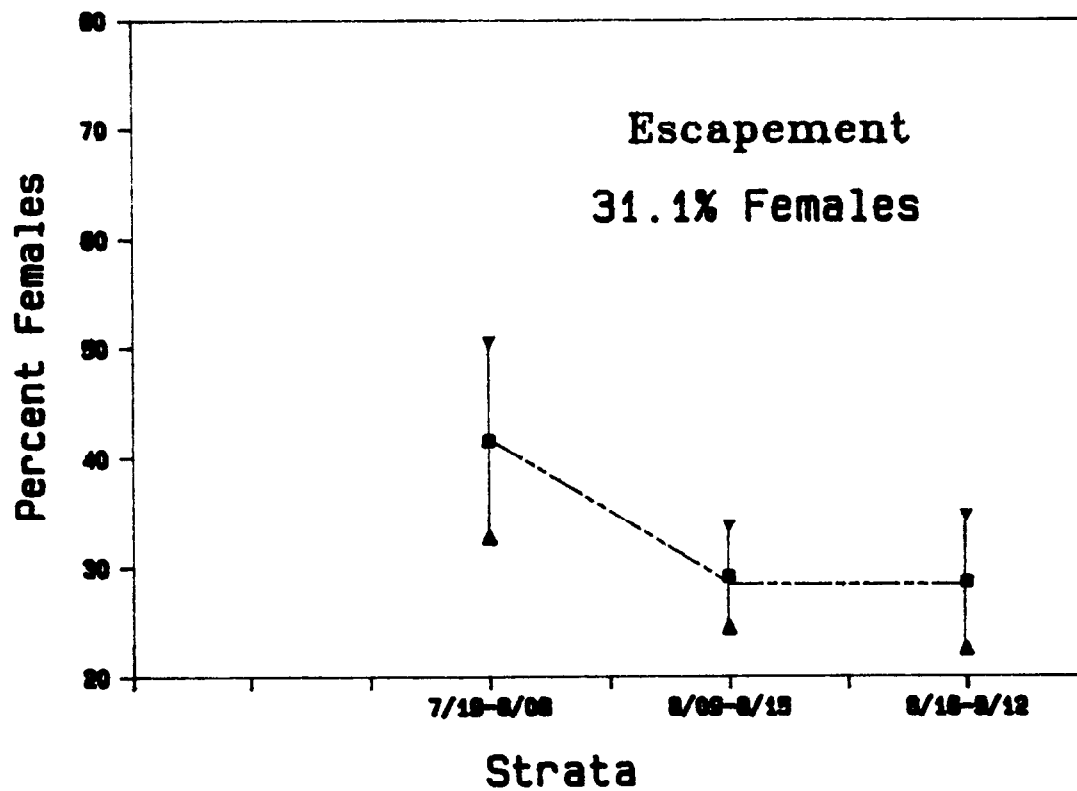
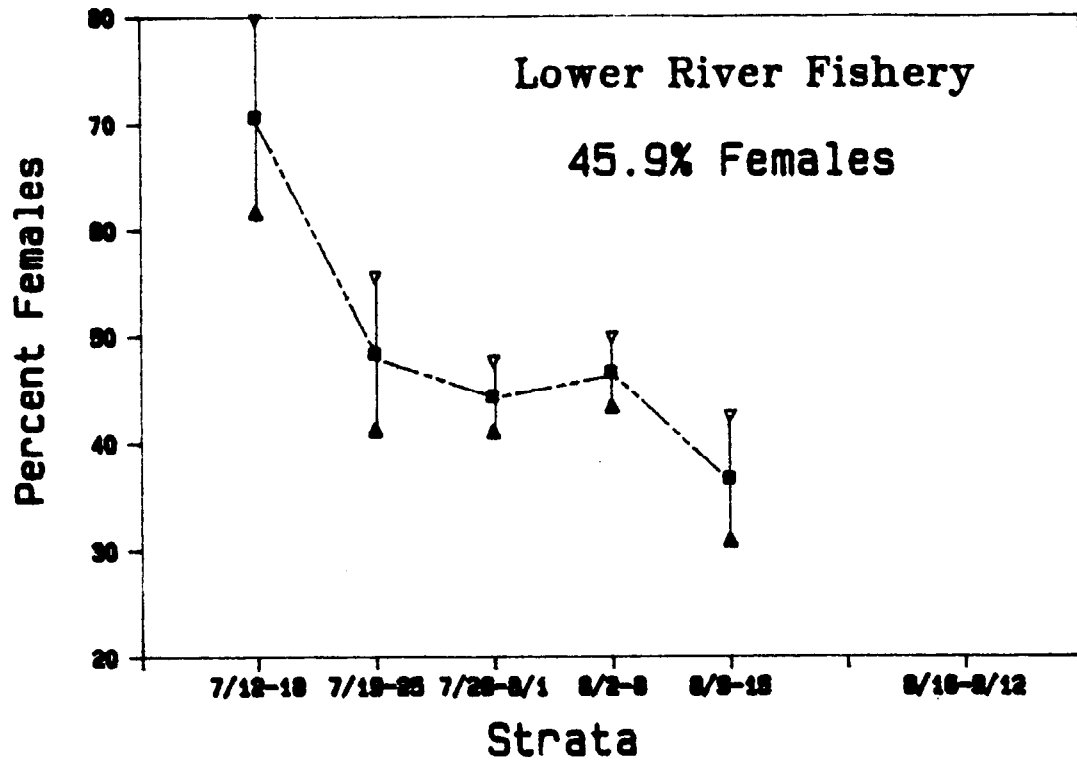


Figure 4. Percent composition with mean values and 95% confidence intervals of female coho salmon in the lower river sport fishery and escapement of the Little Susitna River, 1986.

The premature closure of the fishery also resulted in cancellation of the hooking mortality study. Although there are no previous estimates of the number of released fish, the approximate 1,000 coho salmon caught and released during 1986 probably is low in comparison to previous years. It is hypothesized that this total would have been much higher if the fishery had not been prematurely closed. The prevalence of bait in the lower river fishery reinforces our concerns regarding potential mortality of released fish.

The temporal trends in sex composition have significant implications for management of the fishery. The high incidence of females early in the run is of concern to resource managers in years of low abundance such as 1986. Restricting fishing time during the latter stages of the migration has a greater impact on males than females. The differential selection of females by the fishery during 1986, a result of curtailing fishing during the latter portion of the migration when males were more abundant, is evident from the larger percentage of females harvested by the lower river fishery (45.9%) than was observed at the weir (31.1%). The temporal changes in sex composition also offer promise as a means to quantitatively assess run timing inseason. Establishment of a useable data base will require more intense sampling so that meaningful estimates can be generated by week.

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APPENDIX A

Creel survey data for the Little Susitna River
sport fishery, 1986.

Appendix Table A1. Interview summary for boat anglers who exited the Little Susitna River through Ship Creek, 1986.

Date	Weekend/ Weekday	Hours Censused	Anglers Interv'd	Hours Fished	Total Harvest	Total Catch	Anglers Missed
712	We	8.0	7	13.0	1	1	0
713	We	4.0	4	24.0	3	3	0
714	Wd	0.0	0	0.0	0	0	0
715	Wd	4.0	0	0.0	0	0	0
716	Wd	8.0	8	84.0	22	23	0
717	Wd	4.0	10	45.0	18	20	0
718	Wd	8.0	16	76.0	17	17	0
719	We	8.0	59	443.0	75	75	0
720	We	8.0	58	450.0	30	30	0
721	Wd	4.0	12	100.0	11	11	0
722	Wd	0.0	0	0.0	0	0	0
723	Wd	4.0	2	22.0	0	0	0
724	Wd	4.0	0	0.0	0	0	0
725	Wd	8.0	13	31.0	23	23	0
726	We	8.0	69	396.5	133	141	0
727	We	4.0	46	270.0	78	102	0
728	Wd	4.0	6	42.0	8	8	0
729	Wd	8.0	44	184.5	110	116	0
730	Wd	4.0	0	0.0	0	0	0
731	Wd	8.0	16	75.0	18	23	0
801	Wd	0.0	0	0.0	0	0	0
802	We	8.0	16	116.0	23	23	0
803	We	8.0	96	658.0	110	141	0
804	Wd	4.0	0	0.0	0	0	0
805	Wd	8.0	20	139.5	49	54	0
806	Wd	4.0	13	104.0	7	7	0
807	Wd	0.0	0	0.0	0	0	0
808	Wd	4.0	0	0.0	0	0	0
809	We	8.0	10	98.0	3	3	0
810	We	8.0	26	152.0	10	10	0
811	Wd	8.0	0	0.0	0	0	0
812	Wd	4.0	0	0.0	0	0	0
Total		172.0	551	3,523.5	749	831	0

Appendix Table A2. Interview summary for boat anglers who exited the Little Susitna River through Burma Road, 1986.

Date	Weekend/ Weekday	Hours Censused	Anglers Interv'd	Hours Fished	Total Harvest	Total Catch	Anglers Missed
707	Wd	3.5	15	48.0	0	0	0
708	Wd	3.5	0	0.0	0	0	0
709	Wd	4.0	0	0.0	0	0	0
710	Wd	4.0	5	4.0	0	0	0
711	Wd	3.5	13	27.0	0	0	0
712	We	15.5	11	53.0	6	6	0
713	We	15.5	25	93.2	10	10	0
714	Wd	8.0	6	26.0	0	0	0
715	Wd	7.5	0	0.0	0	0	0
716	Wd	7.5	3	5.0	9	9	0
717	Wd	8.0	26	111.8	22	23	0
718	Wd	7.5	10	66.0	17	17	0
719	We	15.5	79	421.0	50	54	0
720	We	15.5	124	651.7	88	107	0
721	Wd	7.5	56	254.5	35	36	0
722	Wd	7.5	35	212.2	28	28	0
723	Wd	7.5	6	20.3	8	8	0
724	Wd	8.0	43	168.5	119	127	0
725	Wd	8.0	43	199.3	43	49	0
726	We	15.5	86	392.8	175	186	0
727	We	15.5	201	933.4	139	143	0
728	Wd	7.5	59	278.2	112	112	0
729	Wd	8.0	50	171.7	112	112	0
730	Wd	8.0	80	329.0	86	106	0
731	Wd	7.5	54	237.5	74	111	0
801	Wd	7.5	69	348.5	133	185	0
802	We	15.5	229	1,210.0	261	282	0
803	We	15.5	345	1,868.2	282	340	0
804	Wd	7.5	67	371.2	79	96	0
805	Wd	8.0	87	356.8	90	115	0
806	Wd	7.5	30	159.5	49	62	0
807	Wd	7.5	55	257.5	75	124	0
808	Wd	8.0	40	199.5	46	61	0
809	We	15.5	111	466.5	97	135	0
810	We	15.5	155	678.3	133	153	0
811	Wd	8.0	31	138.5	72	112	0
812	Wd	7.5	26	173.7	38	39	0
813	Wd	7.5	43	235.5	47	51	0
814	Wd	7.5	10	37.0	10	16	0
Total		358.0	2,328	11,204.8	2,545	3,015	0

Appendix Table A3. Interview summary for shore anglers who exited the Little Susitna River through Burma Road, 1986.

Date	Weekend/ Weekday	Hours Censused	Anglers Interv'd	Hours Fished	Total Harvest	Total Catch	Anglers Missed
707	Wd	3.5	2	3.5	0	0	0
708	Wd	3.5	0	0.0	0	0	0
709	Wd	4.0	3	2.5	0	0	0
710	Wd	4.0	4	3.0	0	0	0
711	Wd	3.5	4	2.0	0	0	0
712	We	15.5	19	58.3	1	1	0
713	We	15.5	10	13.5	0	0	0
714	Wd	8.0	7	15.5	0	0	0
715	Wd	7.5	9	21.5	0	0	0
716	Wd	7.5	14	43.0	8	13	0
717	Wd	8.0	30	74.8	3	3	0
718	Wd	7.5	27	98.5	8	9	0
719	We	15.5	119	388.5	15	15	0
720	We	15.5	81	237.7	20	23	0
721	Wd	7.5	53	80.5	2	2	0
722	Wd	7.5	7	27.7	0	0	0
723	Wd	7.5	2	0.5	0	0	0
724	Wd	8.0	21	39.8	14	14	0
725	Wd	8.0	38	64.0	0	0	3
726	We	15.5	51	167.7	45	50	0
727	We	15.5	108	317.5	18	18	0
728	Wd	7.5	45	118.3	25	25	0
729	Wd	8.0	19	33.0	11	11	0
730	Wd	8.0	47	105.2	8	8	0
731	Wd	7.5	34	77.0	5	5	0
801	Wd	7.5	79	267.0	13	14	0
802	We	15.5	213	629.2	23	23	4
803	We	15.5	192	548.4	5	5	0
804	Wd	7.5	47	144.1	12	12	0
805	Wd	8.0	61	179.5	4	4	0
806	Wd	7.5	25	94.3	4	4	0
807	Wd	7.5	30	123.0	5	5	0
808	Wd	8.0	20	36.0	3	3	0
809	We	15.5	89	292.5	15	15	5
810	We	15.5	68	175.2	6	6	0
811	Wd	8.0	38	68.2	1	1	0
812	Wd	7.5	34	83.0	4	4	0
813	Wd	7.5	30	83.0	5	5	0
814	Wd	7.5	8	7.2	0	0	0
Total		358.0	1688	4,724.1	283	298	12

Appendix Table A4. Mean harvest, catch, and effort for shore anglers who exited the Little Susitna River through Burma Road, 1986.

Date	Weekend/ Weekday	Sample Size	Effort ¹		Coho Harvest			Coho Catch		
			Mean	Std Err	Mean	Std Err	CPUE	Mean	Std Err	CPUE
707	Wd	2	1.750	0.75000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
708	Wd	0	0.000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
709	Wd	3	0.833	0.16667	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
710	Wd	4	0.750	0.14434	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
711	Wd	4	0.500	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
712	We	19	3.066	0.59996	0.05263	0.05263	0.01717	0.05263	0.05263	0.01717
713	We	10	1.349	0.60899	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
714	Wd	7	2.214	0.51010	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
715	Wd	9	2.389	0.36111	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
716	Wd	14	3.071	0.46839	0.57143	0.29116	0.18605	0.92857	0.52899	0.30233
717	Wd	30	2.494	0.25727	0.10000	0.10000	0.04010	0.10000	0.10000	0.04010
718	Wd	27	3.648	0.41156	0.29630	0.12871	0.08122	0.33333	0.15097	0.09137
719	We	119	3.265	0.17166	0.12605	0.04553	0.03861	0.12605	0.04553	0.03861
720	We	81	2.935	0.22317	0.24691	0.07356	0.08412	0.28395	0.09660	0.09674
721	Wd	53	1.519	0.19307	0.03774	0.02643	0.02484	0.03774	0.02643	0.02484
722	Wd	7	3.964	0.77234	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
723	Wd	2	0.250	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
724	Wd	21	1.897	0.21397	0.66667	0.26125	0.35149	0.66667	0.26125	0.35149
725	Wd	38	1.684	0.19658	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
726	We	51	3.289	0.26572	0.88235	0.17410	0.26826	0.98039	0.19502	0.29806
727	We	108	2.940	0.20909	0.16667	0.06377	0.05669	0.16667	0.06377	0.05669
728	Wd	45	2.628	0.31878	0.55556	0.15749	0.21142	0.55556	0.15749	0.21142
729	Wd	19	1.737	0.20633	0.57895	0.22052	0.33333	0.57895	0.22052	0.33333
730	Wd	47	2.239	0.18422	0.17021	0.09285	0.07601	0.17021	0.09285	0.07601
731	Wd	34	2.265	0.27624	0.14706	0.06165	0.06494	0.14706	0.06165	0.06494
801	Wd	79	3.380	0.26138	0.16456	0.04911	0.04869	0.17722	0.05332	0.05243
802	We	213	2.954	0.14939	0.10798	0.02683	0.03655	0.10798	0.02683	0.03655
803	We	192	2.856	0.16021	0.02604	0.01152	0.00912	0.02604	0.01152	0.00912
804	Wd	47	3.067	0.24643	0.25532	0.10300	0.08324	0.25532	0.10300	0.08324
805	Wd	61	2.942	0.31534	0.06557	0.03959	0.02229	0.06557	0.03959	0.02229
806	Wd	25	3.770	0.51355	0.16000	0.09452	0.04244	0.16000	0.09452	0.04244
807	Wd	30	4.100	0.47474	0.16667	0.08419	0.04065	0.16667	0.08419	0.04065
808	Wd	20	1.800	0.20326	0.15000	0.08192	0.08333	0.15000	0.08192	0.08333
809	We	89	3.287	0.18587	0.16854	0.05357	0.05128	0.16854	0.05357	0.05128
810	We	68	2.577	0.26264	0.08824	0.04049	0.03424	0.08824	0.04049	0.03424
811	Wd	38	1.794	0.15718	0.02632	0.02632	0.01467	0.02632	0.02632	0.01467
812	Wd	34	2.441	0.28500	0.11765	0.09216	0.04819	0.11765	0.09216	0.04819
813	Wd	30	2.767	0.42092	0.16667	0.09689	0.06024	0.16667	0.09689	0.06024
814	Wd	8	0.895	0.24765	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

¹ Hours

Appendix Table A5. Harvest and catch rate estimates for shore anglers who exited the Little Susitna River through Burma Road, 1986.

Wd/ We ¹	Strata	Days		Number of Interviews	Effort ⁴		Harvest				Catch			
		D ²	d ³		Mean	S.E.	Mean	S.E.	CPUE	S.E.	Mean	S.E.	CPUE	S.E.
Wd	707-711	5	3	0	0.00	0.000	0.00	0.000	0.000	0.0000	0.00	0.000	0.000	0.0000
We	712-713	2	2	0	0.00	0.000	0.00	0.000	0.000	0.0000	0.00	0.000	0.000	0.0000
Wd	714-718	5	3	0	0.00	0.000	0.00	0.000	0.000	0.0000	0.00	0.000	0.000	0.0000
We	719-720	2	2	200	3.13	0.141	0.18	0.043	0.056	0.0010	0.19	0.053	0.061	0.0012
Wd	721-725	5	3	121	1.76	0.169	0.13	0.053	0.075	0.0027	0.13	0.053	0.075	0.0027
We	726-727	2	2	159	3.05	0.169	0.40	0.092	0.130	0.0023	0.43	0.103	0.140	0.0026
Wd	728-801	5	3	224	2.68	0.114	0.28	0.059	0.103	0.0015	0.28	0.060	0.105	0.0015
We	802-803	2	2	405	2.91	0.110	0.07	0.015	0.024	0.0002	0.07	0.015	0.024	0.0002
Wd	804-808	5	3	183	3.15	0.166	0.15	0.037	0.049	0.0009	0.15	0.037	0.049	0.0009
We	809-810	2	2	157	2.98	0.161	0.13	0.034	0.045	0.0009	0.14	0.034	0.045	0.0009
Wd	811-814	4	3	110	2.19	0.147	0.09	0.034	0.041	0.0014	0.09	0.034	0.041	0.0014

¹ Weekday (Wd) or Weekend (We).

² Number of days possible for collecting interviews.

³ Number of days on which interviews were collected.

⁴ Hours.

Appendix Table A6. Counts of shore anglers who exited the Little Susitna River above and below Burma Road, 1986.

Date	Weekend/ Weekday	Count by Period ¹			
		A	B	C	D
707	Wd			0	
708	Wd	0			
709	Wd				
710	Wd				
711	Wd				0
712	We				0
713	We	0			
714	Wd				
715	Wd		0		
716	Wd	0			
717	Wd				
718	Wd				0
719	We				4
720	We		3		
721	Wd			0	
722	Wd			0	
723	Wd		2		
724	Wd				
725	Wd				
726	We			0	
727	We	6			
728	Wd				1
729	Wd				
730	Wd				
731	Wd			17	
801	Wd		18		
802	We			17	
803	We		14		
804	Wd		10		
805	Wd				
806	Wd	3			
807	Wd		14		
808	Wd				
809	We		10		
810	We				5
811	Wd				
812	Wd				8
813	Wd			1	
814	Wd	0			

¹ Period A: 0600-0959, Period B: 1000-1359,
Period C: 1400-1759, Period D: 1800-2200

Appendix Table A7. Effort estimates for shore anglers who exited the Little Susitna River above and below Burma Road, 1986.

Wd/ We ¹	Strata	Days		Number of Interviews	Counts		Effort ⁴	
		D ²	d ³		Mean	S.E.	Total	S.E.
Wd	707-711	5	3	0	0.0	0.0	0.0	0.0
We	712-713	2	2	0	0.0	0.0	0.0	0.0
Wd	714-718	5	3	0	0.0	0.0	0.0	0.0
We	719-720	2	2	200	3.5	0.6	112.0	16.0
Wd	721-725	5	3	121	0.7	0.6	53.3	53.3
We	726-727	2	2	159	3.0	3.0	96.0	96.0
Wd	728-801	5	3	224	12.0	5.5	960.0	440.6
We	802-803	2	2	405	15.5	1.5	496.0	48.0
Wd	804-808	5	3	183	9.0	3.2	720.0	257.2
We	809-810	2	2	157	7.5	2.5	240.0	80.0
Wd	811-814	4	3	110	3.0	2.5	192.0	161.1

¹ Weekday (Wd) or Weekend (We).

² Number of days possible for collecting interviews.

³ Number of days on which interviews were collected.

⁴ Hours.

Appendix Table A8. Effort, harvest, and catch estimates for shore anglers who exited the Little Susitna River above and below Burma Road, 1986.

Wd/ We ¹	Strata	Effort ²		Harvest					Catch				
		Total	R.P. ³	Rate	R.P. ³	Total	S.E.	R.P. ³	Mean	R.P. ³	Total	S.E.	R.P. ³
Wd	707-711	0.0		0.000		0	0.0		0.000		0	0.0	
We	712-713	0.0		0.000		0	0.0		0.000		0	0.0	
Wd	714-718	0.0		0.000		0	0.0		0.000		0	0.0	
We	719-720	112.0	28.0%	0.056	3.4%	6	0.9	29.4%	0.061	4.0%	7	1.0	27.5%
Wd	721-725	53.3	196.0%	0.075	6.9%	4	4.0	196.7%	0.075	6.9%	4	4.0	196.7%
We	726-727	96.0	196.0%	0.130	3.5%	12	12.5	203.5%	0.140	3.6%	13	13.4	202.8%
Wd	728-801	960.0	90.0%	0.103	2.8%	99	45.5	90.1%	0.105	2.7%	101	46.2	89.7%
We	802-803	496.0	19.0%	0.024	2.0%	12	1.1	18.8%	0.024	2.0%	12	1.1	18.8%
Wd	804-808	720.0	70.0%	0.049	3.4%	35	12.5	69.9%	0.049	3.4%	35	12.5	69.9%
We	809-810	240.0	65.3%	0.045	3.8%	11	3.6	64.1%	0.045	3.8%	11	3.6	64.1%
Wd	811-814	192.0	164.5%	0.041	6.6%	8	6.7	163.4%	0.041	65.6	8	6.7	163.4%
Total		2,869.3	37.9%			187	49.6	51.9%			191	50.5	51.8%

¹ Weekday (Wd) or Weekend (We).

² Hours.

³ Relative precision at $\alpha = 0.05$.

Appendix Table A9. Interview summary for boat anglers who exited the Little Susitna River through Millers Landing, 1986.

Date	Weekend/ Weekday	Hours Censused	Anglers Interv'd	Hours Fished	Total Harvest	Total Catch	Anglers Missed
726	We	7.0	73	364.0	0	0	0
727	We	3.4	22	82.5	0	0	0
728	Wd	0.0	0	0.0	0	0	0
729	Wd	7.2	19	60.7	1	1	0
730	Wd	3.4	22	62.2	0	0	0
731	Wd	7.0	9	33.5	0	0	0
801	Wd	3.4	26	111.5	4	4	0
802	We	10.2	67	373.5	7	7	0
803	We	6.8	50	240.5	4	4	0
804	Wd	3.3	0	0.0	0	0	0
805	Wd	4.0	74	385.5	33	35	0
806	Wd	6.8	30	137.0	12	12	0
807	Wd	3.6	8	40.5	0	0	0
808	Wd	6.7	38	192.5	6	6	0
809	We	7.0	46	184.0	10	10	0
810	We	10.7	96	409.0	41	42	0
811	Wd	6.8	7	40.5	7	7	0
812	Wd	3.4	9	26.5	5	5	0
813	Wd	3.3	0	0.0	0	0	0
814	Wd	6.7	30	100.7	24	45	0
Total		110.7	626	2,844.6	154	178	0

Appendix Table A10. Counts of shore anglers who exited
the Little Susitna River at the
Parks Highway bridge, 1986.

		Count by Period ¹			
Date	Weekend/ Weekday	A	B	C	D
726	We			23	19
727	We		16	13	
728	Wd	0			5
729	Wd	2		8	
730	Wd		0		
731	Wd	0	0		6
801	Wd	6			9
802	We	2	11	17	10
803	We	11	37	39	35
804	Wd	9			
805	Wd				44
806	Wd	4	17	18	
807	Wd			40	
808	Wd	9		25	21
809	We	9	30	34	29
810	We	21	45	49	
811	Wd	3	8	34	
812	Wd		10		6
813	Wd	10		11	6
814	Wd	4			5

¹ Period A = 0600-0959; Period B = 1000-1359
Period C = 1400-1759; Period D = 1800-2200

Appendix Table A11. Mean harvest, catch, and effort for shore anglers who exited the Little Susitna River at the Parks Highway bridge, 1986.

Date	Weekend/ Weekday	Sample Size	Effort (Hours)		Coho Harvest			Coho Catch		
			Mean	Std Err	Mean	Std Err	CPUE	Mean	Std Err	CPUE
726	We	0	0.000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
727	We	21	2.119	0.30697	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
728	Wd	5	1.134	0.24740	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
729	Wd	0	0.000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
730	Wd	0	0.000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
731	Wd	6	1.333	0.44096	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
801	Wd	5	2.300	0.37417	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
802	We	17	1.720	0.28014	0.11765	0.08055	0.06840	0.11765	0.08055	0.06840
803	We	93	2.288	0.16102	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
804	Wd	0	0.000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
805	Wd	21	1.690	0.23459	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
806	Wd	16	3.500	0.35940	0.31250	0.15052	0.08929	0.31250	0.15052	0.08929
807	Wd	0	0.000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
808	Wd	40	2.175	0.17961	0.07500	0.05533	0.03448	0.07500	0.05533	0.03448
809	We	83	2.093	0.17701	0.03614	0.02061	0.01727	0.03614	0.02061	0.01727
810	We	39	2.060	0.16762	0.05128	0.03578	0.02490	0.05128	0.03578	0.02490
811	Wd	13	1.178	0.22477	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
812	Wd	22	2.379	0.45948	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
813	Wd	0	0.000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
814	Wd	0	0.000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Appendix Table A12. Effort estimates for shore anglers who exited the Little Susitna River at the Parks Highway bridge, 1986.

Wd/ We ¹	Strata	Days		Number of Counts	Counts		Effort ⁴	
		D ²	d ³		Mean	S.E.	Total	S.E.
We	726-727	2	2	4	17.8	2.1	568.0	68.4
Wd	728-801	5	5	10	3.6	1.1	288.0	91.0
We	802-803	2	2	8	20.3	5.1	648.0	163.9
Wd	804-808	5	5	9	20.8	4.6	1,662.2	366.1
We	809-810	2	2	7	31.0	5.2	992.0	165.1
Wd	811-814	4	4	10	9.7	2.8	620.8	181.3

¹ Weekday (Wd) or Weekend (We).

² Number of days possible for collecting interviews.

³ Number of days on which interviews were collected.

⁴ Hours.

Appendix Table A13. Harvest rate estimates for shore anglers who exited the Little Susitna River at the Parks Highway bridge, 1986.

Wd/ We ¹	Strata	Days		Number of Interviews	Effort ⁴		Harvest			
		D ²	d ³		Mean	S.E.	Mean	S.E.	CPUE	S.E.
We	726-727	2	2	21	2.12	0.307	0.00	0.000	0.000	0.0000
Wd	728-801	5	5	16	1.57	0.280	0.00	0.000	0.000	0.0000
We	802-803	2	2	110	2.20	0.162	0.02	0.040	0.008	0.0017
Wd	804-808	5	5	77	2.32	0.368	0.10	0.073	0.045	0.0036
We	809-810	2	2	122	2.08	0.122	0.04	0.021	0.020	0.0009
Wd	811-814	4	4	35	1.93	0.256	0.00	0.000	0.000	0.0004

¹ Weekday (Wd) or Weekend (We).

² Number of days possible for collecting interviews.

³ Number of days on which interviews were collected.

⁴ Hours.

Appendix Table A14. Effort and harvest estimates for shore anglers
who exited the Little Susitna River at the
Parks Highway bridge, 1986.

Wd/ We ¹	Strata	Effort ²		Harvest				
		Total	R.P. ³	Rate	R.P. ³	Total	S.E.	R.P. ³
We	726-727	568.0	23.6%	0.000		0	0.0	
Wd	728-801	288.0	61.9%	0.000		0	0.0	
We	802-803	648.0	49.6%	0.008	41.1%	5	1.7	68.4%
Wd	804-808	1,662.2	43.2%	0.045	15.8%	74	17.4	46.1%
We	809-810	240.0	32.6%	0.020	8.8%	20	3.4	33.0%
Wd	811-814	192.0	57.2%	0.000		0	0.0	
Total		4,779.0	19.8%			99	17.9	35.3%

¹ Weekday (Wd) or Weekend (We).

² Hours.

³ Relative precision at $\alpha = 0.05$.

APPENDIX B
Escapement Data.

Appendix Table B1. Daily escapement by species through weir on the Little Susitna River, 1986.

Date	Coho Salmon	Sockeye Salmon	Chum Salmon	Pink Salmon	Chinook Salmon
717	0	0	100	4	2
718	0	43	303	80	2
719	14	236	711	336	2
720	50	73	683	394	12
721	--1	--1	--1	--1	--1
722	--1	--1	--1	--1	--1
723	--1	--1	--1	--1	--1
724	--1	--1	--1	--1	--1
725	15	61	41	527	0
726	16	69	171	697	0
727	--2	--2	--2	--2	--2
728	--2	--2	--2	--2	--2
729	--2	--2	--2	--2	--2
730	1	7	76	134	0
731	3	40	508	1,658	2
801	22	86	1,038	1,449	4
802	144	514	5,009	6,435	2
803	175	676	5,228	5,332	6
804	228	694	3,028	2,157	4
805	58	110	1,727	1,520	1
806	187	108	876	1,433	2
807	344	112	1,153	2,567	9
808	94	12	517	1,246	1
809	34	11	261	558	0
810	446	28	993	3,344	1
811	225	36	342	1,025	1
812	264	11	235	988	0
813	1,305	28	183	1,202	1
814	933	8	58	1,459	0
815	439	4	39	423	0
816	374	2	40	305	0
817	440	7	51	391	0
818	42	3	16	79	0
819	88	3	21	60	0
820	170	2	25	47	0
821	43	0	16	13	0
822	27	0	25	13	0
823	36	0	11	10	0
824	149	0	25	3	0
825	155	0	26	2	0
826	177	0	11	7	0
827	157	0	3	6	0
828	192	1	11	7	0
829	65	2	3	1	0

--Continued--

Appendix Table B1. Daily escapement by species through weir on the Little Susitna River, 1986.

Date	Coho Salmon	Sockeye Salmon	Chum Salmon	Pink Salmon	Chinook Salmon
830	90	0	33	2	0
831	39	0	4	1	0
901	124	0	14	4	0
902	50	0	6	2	0
903	14	0	1	0	0
904	16	4	0	0	0
905	21	0	6	0	0
906	30	0	4	0	0
907	0	0	1	0	0
908	15	0	6	0	0
Total	7,511	2,991	23,639	35,921	52

¹ Weir inoperative, pickets pulled because of high water.

² Weir washed out by flood water.

Appendix Table B2. Peak coho salmon escapement counts
from Northern Cook Inlet, 1986.

Stream	Survey Date	Number of Coho Salmon Observed
ANCHORAGE BOWL		
Rabbit Creek	9/25/86	169
Cambell Creek	10/02/86	99
Bird Creek	9/15/86	3
Total		271
MATANUSKA VALLEY		
Cottonwood Creek	9/30/86	121
Spring Creek	9/29/86	147
McRoberts Creek	9/25/86	439
Fish Creek	8/26/86	2,166 ¹
Total		2,873

¹ Weir count, plus downstream foot survey on
8/26/86.

APPENDIX C

Calculation of enhanced contribution.

METHODS

Coho salmon were examined for adipose finclips (ad-clipped) at three locations: Ship Creek; Burma Road; and the weir. At the two fishery recovery sites, samplers attempted to recover the head from ad-clipped fish. Heads were not recovered from ad-clipped fish at the weir.

Tag return data from the three recovery sites were tested for homogeneity with a chi-squared test (Snedecor and Cochran 1972). Proportional contribution estimates and variances were computed using the methods outlined in Vincent-Lang (in press):

$$\hat{P}_S = m_C / \theta n_C$$

where:

\hat{P}_S = the proportional contribution of the enhanced stock,

m_C = the number of marks from the enhanced stock observed in the fishery,

θ = the proportion of the enhanced stock marked at the time of release, and

n_C = the number of examined fish.

The variance of \hat{P}_S is:

$$V(\hat{P}_S) = \{m_C / [n_C(n_C - 1)\theta^2]\} * [1 - (m_C/n_C)].$$

RESULTS

A total of 35 ad-clipped fish were recovered out of 4,359 coho salmon examined (Appendix Table C1). Only 21 heads were recovered from these 35 fish. At Ship Creek, fish were already cleaned and the heads were usually not available. Only 12 CWT's were recovered from the 21 heads examined. We assume that the large number of ad-clipped fish with no CWT's are due to tag loss and therefore computed the contribution estimate using all ad-clipped fish.

A chi-squared test of recovery rates among the three recovery sites showed no significant differences ($\alpha=.05$). Therefore, all the data were pooled to estimate the contribution to the combined lower river fishery and escape-ment through the weir. The proportional enhanced contribution was estimated at 0.066 (standard error = 0.01095).

Appendix Table C1. Release and recovery data for enhanced coho salmon that contributed to the Little Susitna River return, 1986¹.

Release Data:

Year	Type	Number Released	Number Marked ²	Proportion Marked
1984	Fingerling	216,508	20,835	0.0962
1985	Smolt	54,000	12,000	0.2222
	Combined	270,508	32,835	0.1214

² Fish were marked with an adipose (Ad) finclip and a coded wire tag (CWT).

Recovery Data:

Recovery Site	Number Examined	Number with Ad-clips	Heads Collected from Marked Fish	Decoded CWT's from Respective Tag Lots	
				Fingerling	Smolt
Ship Creek	749	7	0	0	0
Burma Road	2,825	23	21	1	11
Escapement	785	5	0	0	0
Combined	4,359	35	21	1	11

¹ Source: Chlupach (1987).

DISCUSSION

Little confidence can be placed in this estimate due to the apparent excessive tag loss. By examining only ad-clipped fish, we cannot differentiate between fingerling and smolt releases. Pooling the fingerling and smolt release data precludes our ability to estimate the proportion of marked fish at the time of smolt outmigration. Since the proportion of fingerlings marked was less than that of the smolts (0.0962 and 0.2222, respectively), any mortality suffered by the fingerlings between the time of their release and the release of the smolts would result in a higher estimate of the total proportion of juveniles marked at the time of release. Clearly, some mortality occurred and, in fact, we expect that it was substantial. Therefore, the estimate of the total proportion marked is biased low which translates into an estimate of the proportional contribution which is biased high.

The proportional contribution of fingerling and smolt can be estimated from the Burma Road data. However, an assumption must be made to allocate the nine ad-clipped fish which did not have CWT's. At this time, there is no means to make a reasonable assumption.

Chlupach (1987) reports that the enhanced contribution to the Little Susitna River sport harvest was 10.2%. However, we believe that his estimate, like ours, is biased high.

